The WebRes Project: Web-Based Client-Server Technologies for Multicenter Clinical Research

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The infrastructural costs of multicenter clinical trials include the personnel and material needed to create, duplicate, and mail forms and reminders; to conduct follow-up interviews; and to process all returned data. The magnitude of these investments limits the size and scope of such studies.

The mechanisms of the World Wide Web offer a potential solution to these demands. The Web defines a multimedia, compound-document data paradigm running on a cross-platform, networked, client-server architecture. To date, these capabilities have largely been applied to information presentation purposes. However, with the development of security protocols which provide user authentication, data encryption, and access audit trails, the Web can move beyond a primarily "read only" format. Further, with the nearly universal access to the Web and its modest hardware and software requirements, the Web becomes an ideal mechanism for robust client-server computing in general and medicine in particular.

THE WEBRES PROJECT

The goal of the WebRes Project is to use the Web in clinical research by developing a set of Hypertext Markup Language (HTML) documents for the user interface at the client/browser end, and a set of Common Gateway Interface (CGI) programs for data processing at the server end. Cardiovascular research is the first domain of exploration for this project, but these technologies generalize readily to any clinical domain.

We present here a prototype of these efforts applied to the Seattle Angina Questionnaire (SAQ), a patient-centered cardiovascular functional status assessment tool developed and validated in recent work at multiple sites in the U. of Washington system. [1]

Design

HTML documents handle the user interface. Upon linking to the WebRes Uniform Resource Locator (URL), introductory information is provided and the user's identification information requested. Authorized users are then presented a series of HTML documents for actual patient data entry; entry directly by the patient could be adopted by optional setup of the security scheme.

At the server end are CGI programs for handling data storage, processing, and graphical imaging. Tabular and graphical representations of patient and population data are available to the user.

Implementation

The server application is WebStar running on the Macintosh platform. This server provides performance matching Unix servers. The scriptable Macintosh operating system allows easy interapplication communication to distribute the data storage and visualization functionality across off-the-shelf applications. This system could readily migrate to other server platforms, however. The CGI programs which interface with the http server are written in C++. At the browser end, Netscape is the primary client application running on a variety of hardware platforms, though any HTML browser could be used.

Evaluation

We are prospectively evaluating the WebRes technologies in a continuation of the SAQ study. We expect to document substantial benefit in efficiency measures (time to process a given patient evaluation, time to evaluate data); quality measures (completeness and consistency of data); and costs (investment in software development server hardware vs. mailing, duplication and personnel costs). Greatly enhanced statistical power of clinical studies will result from the vastly larger size enabled by these Web techniques.

CONCLUSIONS

The protocols of the World Wide Web offer a huge and growing potential for distributed computing. The technologies explored in the current work suggest how this potential can be harnessed for increasing the ease and power of clinical research.

Reference

[1] Spertus JA, Winder JA, Dewhurst TA, et al. Development and Evaluation of the Seattle Angina Questionnaire: A New Functional Status Measure for Coronary Artery Disease. Journal of the American College of Cardiology 1995;25:333-41.

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